Experts in fire protection

Oxeo EcoPrevent
Energy-efficient fire prevention systems

TECHNOLOGIES

FIRE PREVENTION SYSTEMS

Energy-efficient fire prevention systems

By using nitrogen, Oxeo EcoPrevent systems provide energy-efficient fire protection with the highest level of safety. They actively prevent fires by reducing the oxygen level. Oxeo EcoPrevent systems stand for availability, flexibility, and effectiveness and are therefore the perfect solution when it comes to fire protection in particularly vulnerable zones.

By establishing an oxygen-reduced atmosphere, Oxeo EcoPrevent systems guarantee permanent fire protection. Operating failures are reduced to a minimum and environmental and property damage caused by fire or the consequences of fire can be ruled out. The ability to supply irreplaceable goods is optimally safeguarded.

Depending on the system, the reduction of the oxygen concentration in the protection zone is either permanent or takes place on demand in case of an emergency through the controlled supply of nitrogen. An open fire cannot break out. Furthermore, the spread of a smoldering fire is kept to a minimum. In contrast to reactive fire fighting using fire extinguishing systems or by the fire department, Oxeo EcoPrevent systems completely preclude fires through oxygen reduction.

The use of nitrogen prevents consequential fire damage caused by extinguishing agent. This can sometimes occur with water-based suppression systems when the water damages sensitive components. In addition, toxic reaction products formed by extinguishing agent and flammable material are prevented, for example in hazardous materials warehouses.

Oxeo EcoPrevent systems can be used wherever conventional fire fighting solutions are problematic or simply unfeasible. This is often the case in hard-to-access zones or in deep-freeze applications. Unlike gas-based extinguishing systems, Oxeo EcoPrevent systems keep the oxygen concentration at a constant level that is harmless to human health by means of the regulated and controlled supply of nitrogen. With gas-based extinguishing systems, by contrast, the oxygen concentration continually rises again after flooding due to leakages in the room. This means that the power supply to the affected protection zone must generally be preventively switched off after a few minutes to prevent re-ignition.

How oxygen reduction works

For a fire to ignite, certain conditions must be met. If a combustible material, ignition energy, and oxygen are in the right ratio to one another, a fire can break out at any time. It is generally very difficult to remove all combustible material from a protection zone or eliminate all potential ignition sources.

The oxygen concentration, on the other hand, can be selectively lowered. Natural ambient air has an oxygen content of nearly 21 vol%. Minimax Oxeo EcoPrevent fire prevention systems reduce the oxygen level in the air in the protection zone by means of the targeted supply of nitrogen to the extent that it is impossible for an open fire to even develop.

If the relevant ignition limits of the combustible materials are not known, Minimax will determine them in tests under realistic conditions and specify the necessary level of reduction. Using Minimax fire prevention systems, fire protection concepts that are tailored to the specific application case can be implemented.

Depending on the fire prevention system, a "fire-proof atmosphere" is either permanently established preventively or only on demand. All variants of the Oxeo EcoPrevent product family can be combined and use a new generation of economical nitrogen generators.

With Oxeo EcoPrevent, protected zones remain accessible and can be used virtually without restriction. Under normal atmospheric pressure, the nitrogen content is completely harmless and non-toxic. Since the natural atmosphere has a nitrogen level of 78 vol%, the human body has adapted to a high nitrogen content in the air. The reduction of the oxygen level to 15 vol% (at sea level) achieved by fire prevention systems roughly corresponds to the absolute oxygen level at an altitude of 3,000 m above sea level.

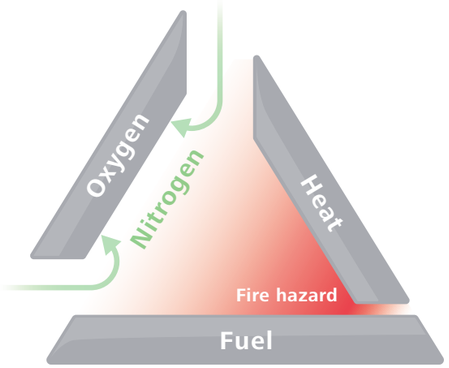


Figure 1: Prerequisites for a fire

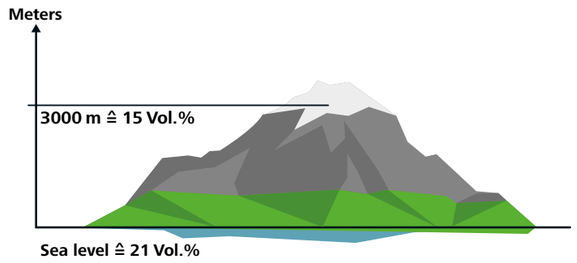


Figure 2: Atmospheric oxygen level of 15 vol%

Design and function – simply efficient

In terms of design and function, Oxeo EcoPrevent fire prevention systems are particularly energy-efficient. Depending on the variant, they require less – or even no – electric energy than conventional oxygen reduction systems in order to deliver a continual supply of nitrogen.

System design

Oxygen sensors in the Oxeo EcoPrevent fire prevention systems constantly monitor the current oxygen level in the protection zone. If, for example, an unintended ambient air entry raises the oxygen concentration, the sensors send a signal to the FMZ 5000 EcoPrevent control panel. The control panel immediately activates the nitrogen supply and oxygen-reduced air is fed into the protection zone via a pipeline system until the preset concentration is uniformly achieved.

Illuminated panels on the access doors indicate the oxygen-reduced protective atmosphere and digitally display the current oxygen level. The protection zone remains accessible for authorized personnel.

Additional safety is provided by the use of a Helios smoke aspiration system. It actively aspirates air samples from the protection zone and evaluates them in a measuring chamber. In this way, even the smallest smoldering fires are detected even earlier.

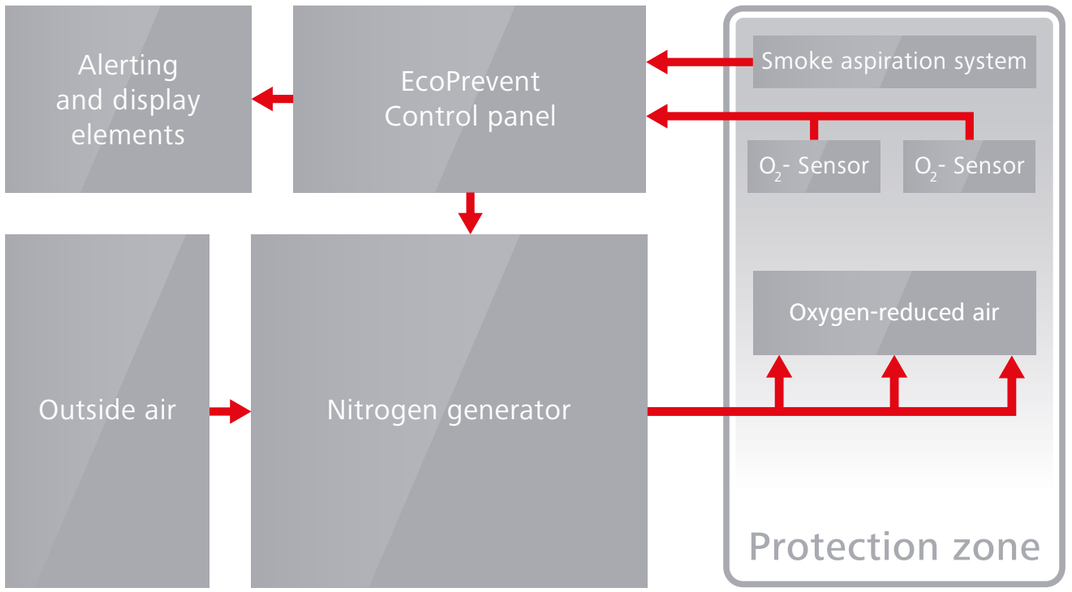
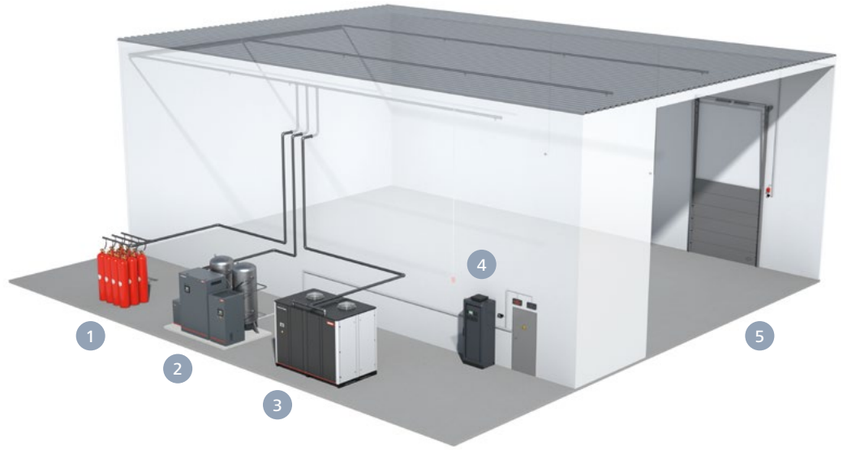


Figure 3: Process schematic of a Minimax oxygen reduction system

All Oxeo EcoPrevent fire prevention systems consist of a nitrogen source, control panel, the protection zone with oxygen sensors, alarm devices, and pipework to feed in oxygen-reduced air.

With regard to the type of nitrogen source used, the Minimax fire prevention systems are divided into the Oxeo EcoPrevent VG variant with a VPSA nitrogen generator, the Oxeo EcoPrevent PG with PSA nitrogen generators, and the Oxeo EcoPrevent CS with cylinder batteries.

Combinations of different variants, which are individually tailored to the respective customer requirements, are also possible.



1	Oxeo EcoPrevent CS
2	Oxeo EcoPrevent PG
3	Oxeo EcoPrevent VG
4	EcoPrevent Control panel
5	Protection zone

Figure 4: Overview of Oxeo EcoPrevent system variants

Oxeo EcoPrevent PG (PSA generator)
The PSA nitrogen generation system works on the basis of pressure swing adsorption and removes oxygen using adsorbents. Vessels filled with granulated carbon are used to separate out the oxygen and thus reduce the oxygen level in the air. The granulate consists of specially treated activated carbon, which enables the separation of oxygen and nitrogen. In the process, the system consumes less compressed air and thus less energy than conventional PSA and membrane systems. Unlike the Oxeo EcoPrevent VG variant, the PG variant uses a separate compressed air source with a pressure level of 6 to 9 bar(g) and suitable compressed air treatment. The air factor (efficiency of the N2 generator in terms of the required amount of compressed air) and the low power consumption of the air compressors have been fully optimized meaning that our new PSA systems guarantee maximum efficiency with relatively low investment costs. In many cases, the cost efficiency of a PSA system can be increased by using a heat recovery system to produce hot water in the heating circuit.

The PSA generators can also be supplied via the customer's already existing compressed air network.

Oxeo EcoPrevent PG systems offer a user-friendly interface, including an online diagnosis platform with a variety of options to economically and reliably control and monitor the system. This is where all the information from the standard sensors, such as pressure dew point, oxygen, and volumetric flow sensors, ensure the efficient operation of the N2 generator.

The sophisticated components have been shaped by many years of development and project planning experience. The result is reliable components, whose use within the system limits is permanently monitored. This forms the basis for safe and reliable operation and, together with appropriate maintenance, ensures the longevity of the system.

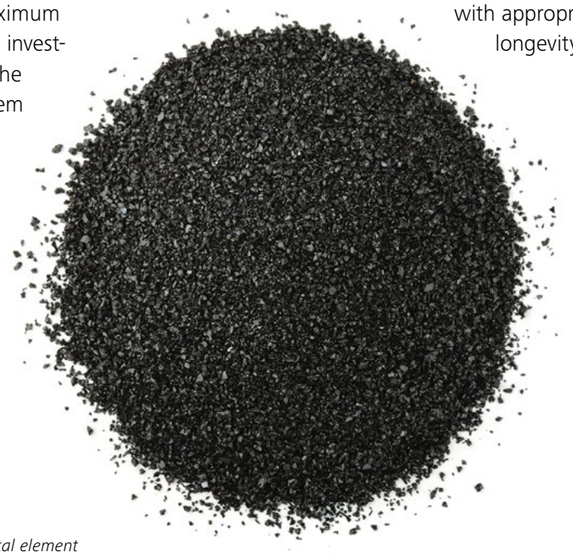
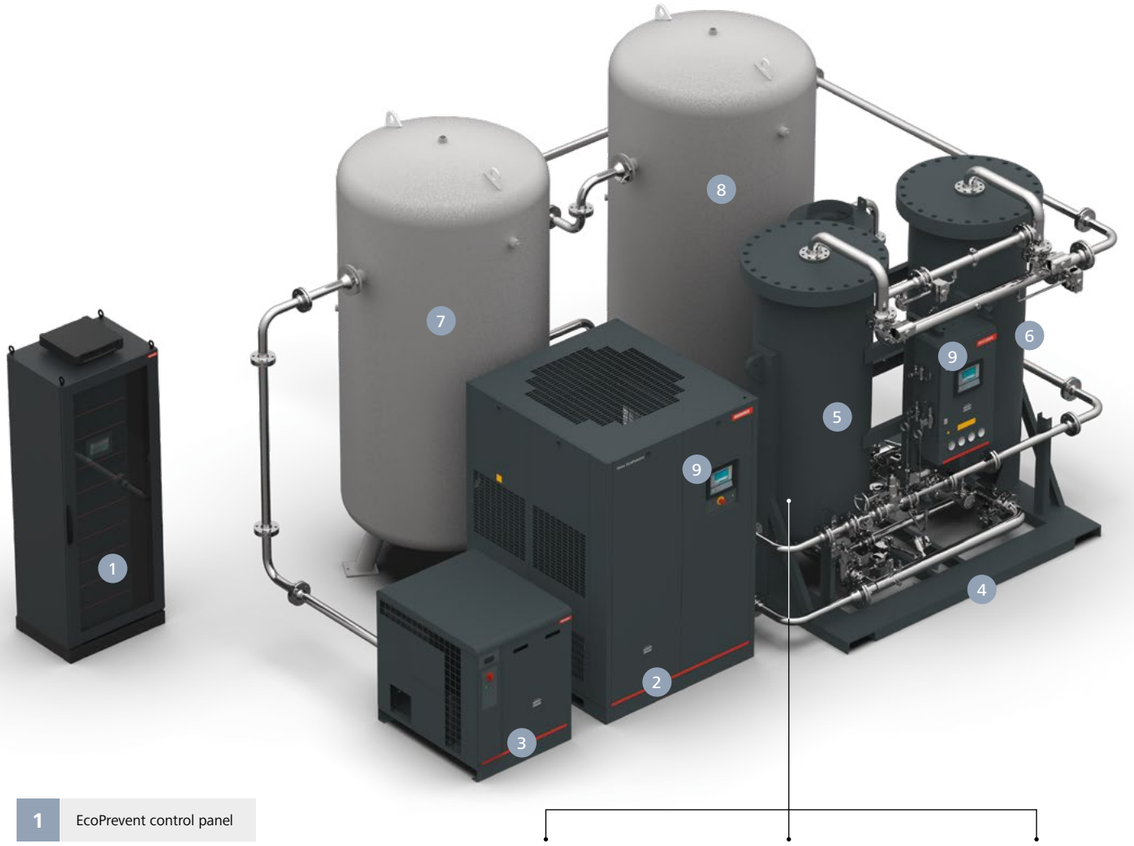
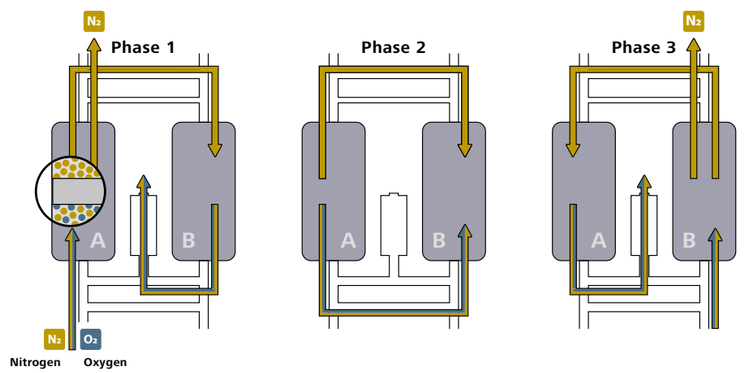


Figure 7:
Granulated carbon is the fundamental element used to separate nitrogen and oxygen molecules in PSA and VPSA technology.



1	EcoPrevent control panel
2	Compressor
3	Refrigeration dryer
4	PSA generator
5	Vessel A
6	Vessel B
7	Compressed air vessel
8	Process vessel
9	Control display

Figure 8: Design of the Oxeo EcoPrevent PG



In the first process step, the supply of compressed air puts vessel A into the adsorption phase, while vessel B is being regenerated (desorption). In the second phase, the pressure of the two vessels is equalized. Once pressure equalization has taken place, vessel B generates nitrogen, while vessel A is being regenerated.

1 EcoPrevent control panel	2 Control display	3 Process vessel	4 Nitrogen outlet
5 VPSA module 1, incl. integrated compressor and vacuum pump		6 VPSA module 2, incl. integrated compressor and vacuum pump	

Figure 9: Design of the Oxeo EcoPrevent VG; for further details on the operating principle, see Figure 7 on page 8

Oxeo EcoPrevent VG (VPSA generator)

Similarly to PSA technology, the VPSA nitrogen generation system also works on the basis of pressure swing adsorption. Due to the low process pressures, VPSA technology – unlike PSA technology – uses an integrated vacuum pump, which regenerates the granulated carbon.

The compressed ambient air is fed into an adsorption vessel by an also integrated energy-efficient low-pressure compressor. This contains the granulated carbon, which retains the smaller oxygen molecules from the air in its pores. The nitrogen is able to flow past and is thus separated from the oxygen. A cycle lasts approximately 60 seconds and comprises nitrogen separation in one vessel (adsorption) and the removal of the bound oxygen into a second vessel (desorption) by means of the vacuum pump. Since this process continuously repeats in alternation, nitrogen is constantly available for discharge into the protection zone.

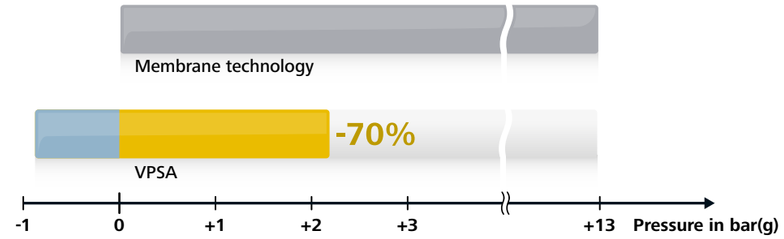


Figure 10: Comparison of the process pressure of membrane vs. VPSA technology

Thanks to the compact design and small dimensions of the VPSA system, it is possible to implement the entire oxygen reduction system as a vessel solution. This saves valuable space in buildings.

Figure 11: Oxeo EcoPrevent VG as a vessel solution

Due to the low process pressures, operation of the VPSA nitrogen reduction system is extremely energy-efficient. Reducing the system pressure directly leads to an effective decrease in energy consumption. In direct comparison with conventional oxygen reduction systems such as membrane systems, energy costs can be reduced by up to 70%. Furthermore, the low process pressure is gentle on components and the granulated carbon and thus reduces the wear on components, which also minimizes the servicing requirements in comparison with other nitrogen generators.

The scalable design allows for individual delivery quantities. From certain delivery quantities, the modular design offers integrated part redundancy. If a module requires maintenance or potentially fails completely, another part of the delivery quantity remains available. This capability is often sufficient to maintain fire protection or, where necessary, to gain time for the complete restoration of fire protection.

Oxeo EcoPrevent CS (cylinder storage)
When a fire breaks out, thermolysis gases are removed before aerosols or smoke particles even have a chance to form. The Oxeo EcoPrevent CS system detects these thermolysis gases at an early stage and reduces the oxygen concentration in the protection zone by means of the controlled supply of nitrogen until a "fire-proof atmosphere" is produced. It then switches to "prevention mode."

The oxygen concentration in the protection zones is continually measured by appropriate sensors and forwarded to the FMZ 5000 EcoPrevent CS control panel. Controlled inert gas tracking takes place on the basis of the measured oxygen concentration. Consequently, prevention mode or, in case of specific events, intervention mode is sustained for a period of time agreed with the operator. In case of emergency, this provides the scope necessary to locate and eliminate the cause of thermolysis gas formation. This makes it unnecessary to switch off the air conditioning and productive IT systems – an advantage given the high availability requirements of data centers.

In the event of unusually severe fire growth, such as due to a short circuit or a high energy arc, aspirating smoke detectors detect the smallest amounts of aerosol or smoke particles and the system switches to "intervention mode": Feeding in additional nitrogen establishes an extinguishable atmosphere. By additionally changing over to intervention mode, the system can extinguish a fire in the same way as an inert gas extinguishing system.

The inert gas in the Oxeo EcoPrevent CS is stored in cylinder batteries. This applies for changeovers to prevention mode or, if applicable, intervention mode as well as for tracking the respectively defined oxygen concentration in these two functional conditions. The on/off vessel valves developed by Minimax are flow-optimized and ensure that the inert gas flow is controlled reliably according to the respective signals from the control panel.

With the Oxeo EcoPrevent CS – in contrast to systems with permanent oxygen reduction – virtually no energy costs are incurred. Inert gas is only supplied to the protection zones on demand, i.e. when thermolysis gases are detected. On-site production of the inert gas by means of compressors, compressed air preparation, and nitrogen generators is not necessary.

Thanks to the modularity of cylinder batteries, the inert gas supply can easily grow alongside expansions of the protection zones. In this way, it offers a more flexible solution than compressors and nitrogen generators.

Zones protected with Oxeo EcoPrevent CS are freely accessible when the system is in the operating status, as the natural oxygen concentration is only reduced when required. No occupational health examinations are required for employees to spend time in zones with an oxygen concentration above 17 vol%. Use in rooms with permanently occupied workstations is also entirely feasible. It is only necessary to leave the affected protection zone when the Oxeo EcoPrevent CS system switches from the operating status to prevention mode due to the detection of thermolysis gas.

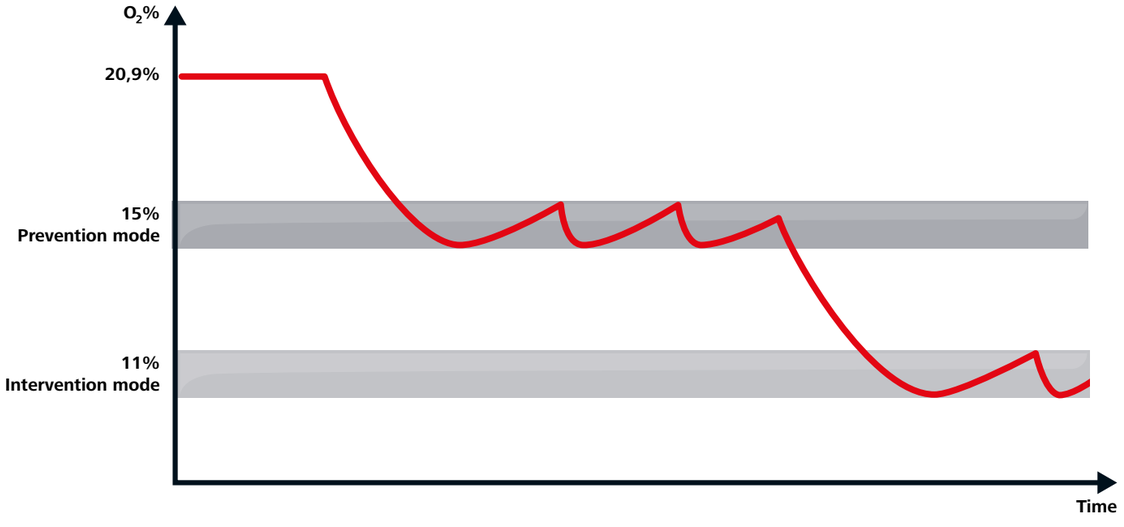


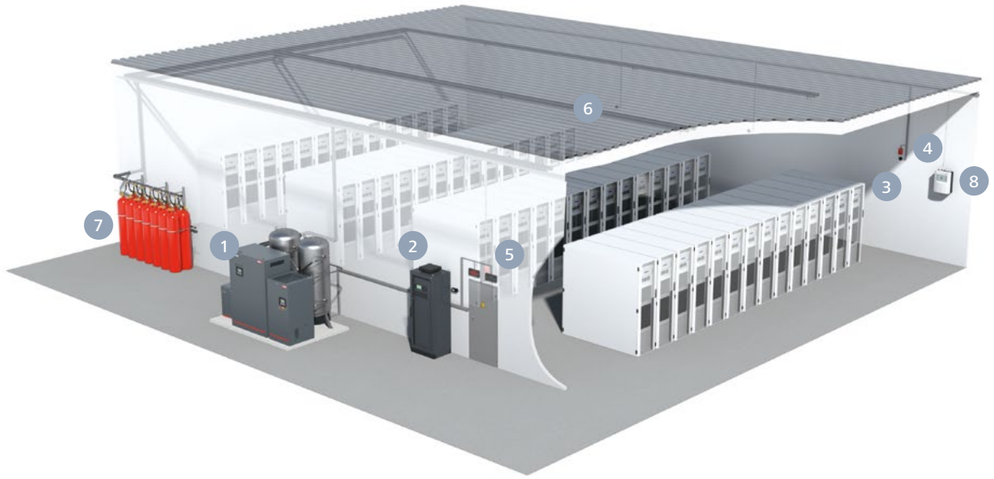
Figure 12: Control curve of the Oxeo EcoPrevent CS with prevention mode and intervention mode

Hybrid solutions
In some projects the fire protection solution can be individually tailored and further optimized by combining different system variants.

Thus, Oxeo EcoPrevent PG (PSA generator) and CS (cylinder storage) are an ideal combination and form an innovative solution for data centers and other applications.

In prevention mode 1, the PSA nitrogen generator permanently keeps the oxygen level within the control range of 17 vol%, thus keeping the protection zone freely accessible. In case of an early detection, the cylinder battery is activated and reduces the oxygen concentration to, for example, 15 vol% in prevention mode 2. The concentration is kept within the control range through the use of the nitrogen generator and the on-demand discharge of nitrogen from the cylinder battery.

If the aspirating smoke detector detects aerosols or the smallest amount of smoke particles, the system activates intervention mode via the control panel. The cylinder battery reduces the oxygen level in the protection zone to 11 vol%, for example, to produce an extinguishable atmosphere and maintains this level for a pre-defined hold time.



1	Oxeo EcoPrevent PG	2	Control panel	3	Oxygen sensor	4	Beacon/horn
5	Illuminated warning display	6	Nitrogen nozzle	7	Cylinder batteries	8	Helios AMX 5000 Aspirating smoke detector

Figure 13: Structure of Oxeo EcoPrevent PG/CS as a hybrid solution

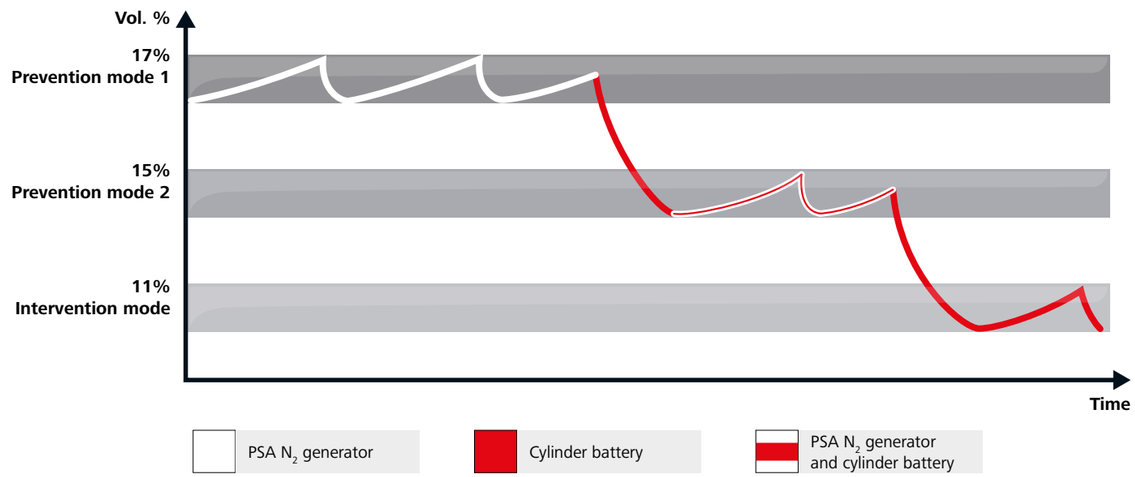
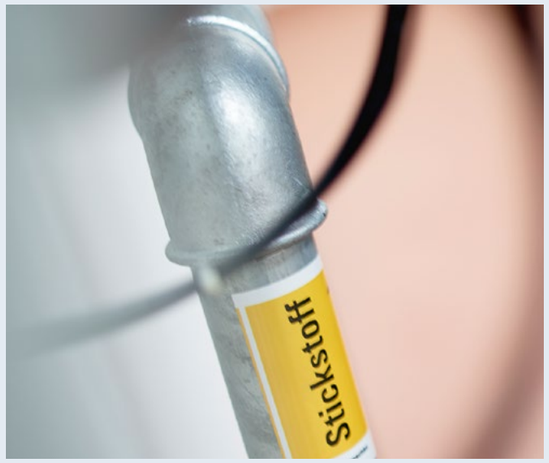


Figure 14: Control curve of the Oxeo EcoPrevent PG/CS hybrid solution

Oxeo EcoPrevent ES (external supply)
If a nitrogen source within reach of the protection zone is already available on site, the Oxeo EcoPrevent ES oxygen reduction system builds on it with an individual solution consisting of a corresponding selector valve and control panel to control the supply of nitrogen to the protection zones. This system is easy to set up and the customer incurs no additional costs for nitrogen generation.



Applications – a class of their own

As a result of their differing characteristics, Oxeo EcoPrevent fire prevention systems are suitable for a variety of applications. Thanks to the modularity of the system configuration, Oxeo EcoPrevent fire prevention systems can be tailored to the respective application case.

Automated deep-freeze warehouses and cold stores
In particular, the dry air in deep-freeze warehouses and cold stores facilitates rapid fire propagation. The insulating materials used constitute a high fire load. At the same time, the watertight building envelope provides an ideal prerequisite for the operation of a fire prevention system.

Flammable liquids warehouses and automated high-rack warehouses
Fires have devastating consequences for people, delivery capabilities, and the environment. The fire load is particularly high when a large number of goods are stored in limited space. In the case of fully automated conveyor technology, potential electrical defects pose a fire risk.

Telecommunications and data processing
The high availability of IT is paramount! The overheating of technical equipment and short circuits pose a significant fire risk. The high concentration of installed electrical components increases the fire risk. If not detected early enough, even the smallest of fires can result in major losses if data is irrevocably destroyed.

Museums, safes, and archives
Easily flammable materials and technical defects in devices such as the motors of electric mobile racking systems can result in a serious fire. Unique cultural or scientific goods are then often irrevocably destroyed.

Oxeo EcoPrevent				
Applications	**VG**	**PG**	**CS**	**ES**
Archive rooms	●	●		
Production areas	●	●		●[1]
Museums	●	●		
Data centers	●	●	●	
High-rack warehouses	●	●		
Cold stores	●	●		
Deep-freeze warehouses	●	●		
Hazardous materials and flammable liquids warehouses	●	●	●	
Silos	●	●		●[1]

[1] *Advisable when nitrogen is available on site*

Quality through certification
The high reliability of the complete system is guaranteed by taking into account the VdS guideline for planning and installation as well as the current DIN EN 16750 and ISO 20338 standards.

Minimax is a VdS-certified installer of oxygen reduction systems. All Oxeo EcoPrevent fire prevention systems have VdS certification.

There are many reasons for Oxeo EcoPrevent fire prevention systems:

- Prevention instead of reaction:
  Fires cannot even occur
- No consequential damages caused by strong smoke gas development, short circuits, or extinguishing agent
- Protection zones remain accessible
- Operational interruptions are minimized
- Nitrogen supply enables flexible and independent use of the protection zone
- An economical and particularly efficient fire protection solution thanks to innovative nitrogen generators
- Environmentally-friendly, as no fire debris or contaminated extinguishing agent residues have to be disposed of

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